Section 7.5 Questions

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Understanding Concepts

1. $A = 2.0 \times 10^{-10}$ m
   Δd for 1 cycle = $4(2.0 \times 10^{-10}$ m)
   $= 8.0 \times 10^{-10}$ m
   number of cycles in 1 min (60 sec) = (3000 Hz)(60 s)
   $= 1.8 \times 10^{5}$ cycles
   Δd for 3.0 kHz = $(1.8 \times 10^{5}$ cycles$)(8.0 \times 10^{-10}$ m/cycle)
   $= 1.4 \times 10^{-4}$ m
2. Some hunters have a loss of hearing in the ear that is next to the gun. The intensity of the sound of a gunshot would be greatest in the ear next to the gun and, over time, repeated exposure to the intense sound could lead to loss of hearing. The intensity of the sound decreases as the distance from the source increases. Handgun shooting may not be as hazardous since the gun is not next to the ear. In both cases, the wearing of earplugs or ear protectors is advised.
3. The person with the threshold of hearing of 10 dB would have better hearing; this person would be able to hear sounds 100 times less intense than the person with the 30-dB threshold.

7.6 THE REFLECTION OF SOUND WAVES

Try This Activity: Simple Reflection

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The ticking of the clock (or some other periodic source of sound) will be heard most clearly through the receiving tube when the angle of incidence and angle of reflection are equal. This agrees with the Law of Reflection in optics.

PRACTICE

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Understanding Concepts

1. $d = 2(86 \text{ m})$
   $d = 172 \text{ m}$

   $$v = \frac{\Delta d}{\Delta t}$$
   $$= \frac{172 \text{ m}}{0.50 \text{ s}}$$
   $v = 344 \text{ m/s or } 3.4 \times 10^{2} \text{ m/s}$
2. $$v = \frac{\Delta d}{\Delta t}$$
   $$= \frac{420 \text{ m}}{0.30 \text{ s}}$$
   $v = 1400 \text{ m/s or } 1.4 \times 10^{3} \text{ m/s}$
3. $\Delta d = v\Delta t$
   $= (1500 \text{ m/s})(0.40 \text{ s})$
   $\Delta d = 600 \text{ m}$

   $$\text{distance to bottom} = \frac{600 \text{ m}}{2}$$
   $$= 3.0 \times 10^{2} \text{ m}$$
4. $\Delta t = \frac{1}{2}(0.12 \text{ s})$
   $\Delta t = 0.06 \text{ s}$

   $\Delta d = v\Delta t$
   $= (1480 \text{ m/s})(0.06 \text{ s})$
   $\Delta d = 88.8 \text{ m or } 89 \text{ m}$

Making Connections

5. The curved surface of a parabolic microphone reflects sound waves to the microphone, located at the focal point, in effect concentrating and amplifying the sound waves. You can reproduce the effect of a parabolic microphone by cupping your hands around your ear.

Section 7.6 Questions

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Understanding Concepts

1. $\Delta d = v\Delta t$
$= (350 \text{ m/s})(3.5 \text{ s})$
$\Delta d = 1225 \text{ m}$

$\text{distance to wall} = \frac{1225}{2}$
$= 612.5 \text{ m or } 6.1 \times 10^2 \text{ m}$

2. The time for the stone to fall:
$\Delta d = 180 \text{ m}$
$a = 9.8 \text{ m/s}^2$

$\Delta d = v_0 \Delta t + \frac{1}{2} a (\Delta t)^2$
$\frac{2\Delta d}{a} = (\Delta t)^2$
$\Delta t = \sqrt{\frac{2(\Delta d)}{a}}$
$= \sqrt{\frac{2(180)}{9.8}}$
$\Delta t = 6.06 \text{ s}$

The time for the sound to travel:
$v = 332 \text{ m/s} + \left(0.59 \frac{\text{m/s}}{\text{°C}}\right) t$
$= 332 \text{ m/s} + \left(0.59 \frac{\text{m/s}}{\text{°C}}\right)(20.0\text{°C})$
$v = 344 \text{ m/s}$

$\Delta t = \frac{\Delta d}{v}$
$= \frac{180 \text{ m}}{344 \text{ m/s}}$
$\Delta t = 0.52 \text{ s}$

The total time elapsed is $\Delta t = 6.06 \text{ s} + 0.52 \text{ s}$ or 6.58 s.

3. $v = 332 \text{ m/s} + \left(0.59 \frac{\text{m/s}}{\text{°C}}\right) t$
$= 332 \text{ m/s} + \left(0.59 \frac{\text{m/s}}{\text{°C}}\right)(10.0\text{°C})$
$v = 338 \text{ m/s}$

$\Delta d = v\Delta t$
$= (338 \text{ m/s})(11.0 \text{ s})$
$\Delta d = 3718 \text{ m}$

$\text{distance to cliff} = \frac{3718 \text{ m}}{2}$
$= 1859 \text{ m or } 1.86 \times 10^3 \text{ m}$

Making Connections

4. The sound waves are reflected along the inside surfaces of the stethoscope to the doctor's ears. Since these waves do not spread out, the resulting sound has a greater intensity than it normally would at that distance from the source.
5. When sound waves are reflected from ships most of the energy is reflected. However, because the waves from thermal currents are partially transmitted and partially reflected, the echoes from the thermal currents are weaker.
6. A bat emits high-frequency sounds that reflect off objects. The bat interprets the reflected sound to determine the size and location of the object that reflected the sound. Not all types of bats use ultrasonic sound to locate prey.
7. Ultrasound can be used to detect defects in welded joints, to drill holes in glass and steel, and to clean electronic parts of watches and other instruments.

Reflecting

8. Answers will vary with students. Answers could include ultrasound images of a foetus (pregnancy-related ultrasound), prostrate, and breast.